ISSN (print) 0093-4666 © 2010. Mycotaxon, Ltd. ISSN (online) 2154-8889

MYCOTAXON

DOI: 10.5248/113.129

Volume 113, pp. 129–136 *July–September 2010*

Disciseda bovista, recently collected from northern Italy, and *Lycoperdon defossum,* a synonym of *D. candida*

Alfredo Vizzini* & Luigi Panno

alfredo.vizzini@unito.it
Dipartimento di Biologia Vegetale - Università degli Studi di Torino
Viale Mattioli 25, I-10125, Torino, Italy

Abstract — The rare *Disciseda bovista* is described from northern Italy (Piedmont) based upon a recent collection. This is the second documented collection of the species from Italy, and the first in recent times. The study of Vittadini's original material labelled as *Lycoperdon defossum*, a taxon considered by many authors as a synonym of *D. bovista*, reveals that it should be ascribed to *D. candida* and, as such, represents the first record of the species from Italy.

Key words — *Agaricales, Lycoperdaceae, Catastoma,* red lists, taxonomy

Introduction

Disciseda Czern. (= *Catastoma* Morgan) is a genus belonging to the gasteroid lineage of the *Agaricaceae* Chevall. s.l. (Bates et al. 2009, Gube 2009), where it forms the *Disciseda*-clade (Larsson & Jeppson 2008), which is basal to the rest of the taxa formerly placed within the *Lycoperdaceae* Chevall. The genus has a worldwide distribution, but all the species are restricted to xeric habitats. In the latest edition of the Dictionary of the Fungi (Kirk et al. 2008), fifteen *Disciseda* species are recognized.

The genus is characterized by semi-hypogeous basidiomes with a loose mycelial connection, and a peculiar type of dehiscence (e.g. Mattirolo 1934, Ahmad 1950, Mitchel et al. 1975, Jeppson 1997, Calonge 1998, Moreno et al. 2003). The ostiole develops in the basal zone of the endoperidium; then the exoperidium cracks along the circumference of the basidiome and the upper part gets detached from its hypogean portion. When disturbed by atmospheric agents, the detached basidiome will turn over and, consequently, exposes the basal portion of the endoperidium, which places the ostiole in the apical

* Corresponding author

position. The portion of the exoperidium that initially covered the apical parts of the semi-hypogeous basidiome remains attached to the base as a kind of cap encrusted with soil particles and vegetal debris. Kreisel (1962) termed these fungi 'geanemochorous tumblers', since the whole basidiome is blown by the wind, causing basidiospore dispersal.

This paper reports on the occurrence of the rare and threatened *Disciseda bovista* in Piedmont, northern Italy, and provides observations on previous Italian collections. Furthermore, we provide our analysis of Vittadini's collection originally labelled *Lycoperdon defossum*, a taxon considered by some mycologists to represent a synonym of *D. bovista*.

Material and methods

The macro- and micromorphological features are described from notes taken from fresh material. The micromorphological features were observed from dried material mounted in distilled water and Congo red. Spore size is expressed both as a range and mean value based on 26 randomly chosen basidiospores. Basidiospore measurements do not include either sterigma or ornamentation.

Author citations follow Index Fungorum (http://www.indexfungorum.org/Names/AuthorsOfFungalNames.asp). Herbarium abbreviations are according to Thiers (2010).

Taxonomy

Disciseda bovista (Klotzsch) Henn., Beiblatt zur Hedwigia 42: 128, 1903, sub "Lloyd, G.G. *Catastoma*". Figs. 1a–g

≡ *Geastrum bovista* Klotzsch, Nov. Actorum Acad. Caes. Leop.-Carol. Nat. Cur. 19(Suppl. 1): 243, 1843.

≡ *Catastoma bovista* (Klotzsch) Hollós, in Hennings, Verh. Bot. Vereins Prov. Brandenburg 43: VI, 1901.

= *Globaria debreceniensis* Hazsl., Verh. Zool.-Bot. Ges. Wien 26: 226, 1876.

≡ *Bovista debreceniensis* (Hazsl.) De Toni, Sylloge Fungorum 7: 476, 1888.

≡ *Catastoma debreceniense* (Hazsl.) Hollós, Termés. Közl. 56: 186, 1900.

≡ *Disciseda debreceniensis* (Hazsl.) Hollós, Termés. Füz. 25: 102, 1902.

= *Bovista subterranea* Peck, Bot. Gazette (Crawfordsville) 4(10): 216, 1879.

≡ *Catastoma subterraneum* (Peck) Morgan, J. Cincinnati Soc. Nat. Hist. 14: 143, 1892.

≡ *Disciseda subterranea* (Peck) Coker & Couch, Gast. East. U.S. and Canada: 141, 1928.

Selected descriptions: Kers (1975: 420–427); Calonge (1998: 79–80).

Selected iconography: Mattirolo (1934: Figs. 1–16); Kers (1975: Fig. 2); Jeppson (1997: Fig. 1); Jordal et al. (2007: Fig. 1).

Basidiome (8–)10–26 mm in diam. × 9–15 mm in height, globose, subglobose, regular to gibbous, sometimes lobed and depressed, mottled. Immature basidiomes completely enveloped by the exoperidium (Fig. 1a) resembling the protective cases of some trichopteran larvae. Mature basidiomes enveloped at the base by remnants of the exoperidium that forms a thick mycelial pad, heavily

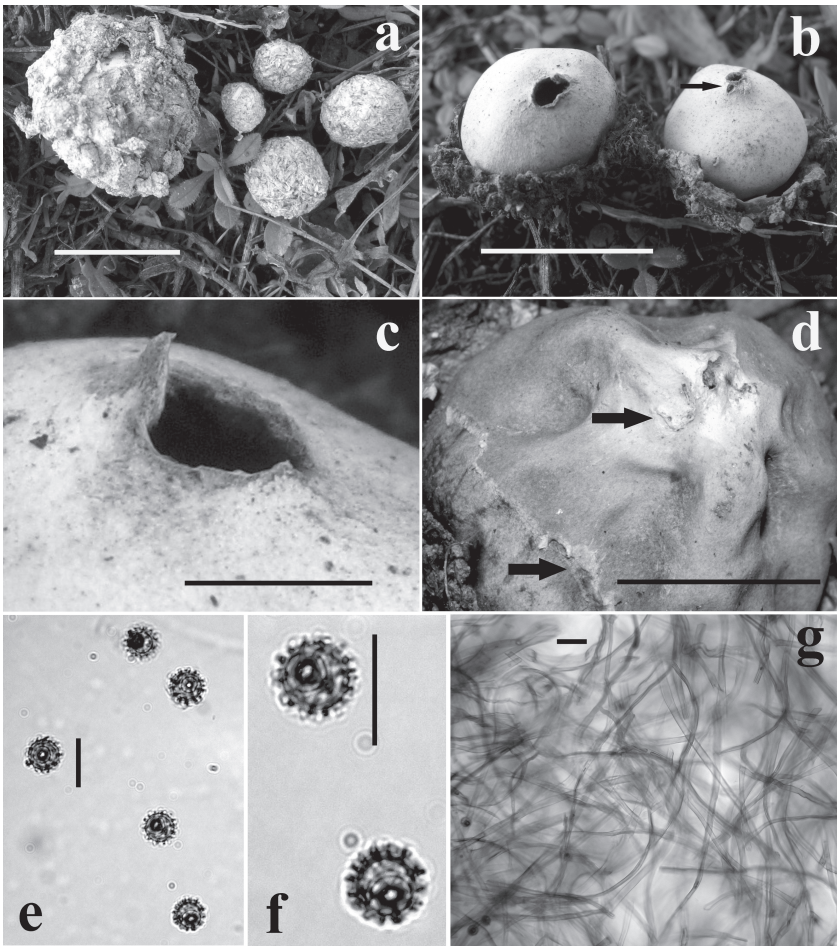

Figure 1. *Disciseda bovista* (TO HG1998). a. Immature basidiomes with intact and encrusted exoperidium. b. Ripe and inverted basidiomes with crumbling exoperidium; arrow = double ostiole. c. Ostiole. d. Mottled endoperidium lacking an evident ostiole, with remnants of the pseudoparenchymatic exoperidial layer (arrows). e, f. Basidiospores. g. Capillitium. Bars: a = 10 mm; b = 20 mm; c = 2mm; d = 20 mm; e, f = 10 µm; g = 20 µm.

encrusted with plant debris and particles of soil (Fig. 1b). Old basidiomes often colonized by green algae. Ostiole (1–)2 mm in diam., orbicular to irregularly-shaped and torn (Fig. 1c); in some ripe specimens no ostiole has been observed; occasionally additional little ostioles are present. Exoperidium colour very difficult to discern as the exoperidium is heavily encrusted with debris,

whitish to greyish brown. Endoperidium white to light grey, then yellowish-brown, coriaceous, leathery, persistent, glabrous to rimulose-pubescent, often with small patches, remnants of the pseudoparenchymatic exoperidial layer (Fig. 1d). Gleba light brown to dark brown, cottony at first, soon becoming pulverulent.

Basidiospores (5.8–)6.0–7.4(–7.6) × (5.5–)5.8–7.0(–7.1) µm, on average 6.68 × 6.38 µm, Q = 1.0–1.07, Qm = 1.046 (*n* = 26), globose, baculate, *Terfezia*-like, warts cylindrical or truncate-conical, up to 0.5–1 µm long, yellowish brown in water mounts, with a central to eccentric large oil drop (Fig. 1e, f); sterigmal remnants (pedicels) short (up to 2–3 µm in length) or absent. Capillitium of the *Lycoperdon*-type, 2.5–5 µm in diam., with rounded tips, thick-walled (up to 1.0 µm), fragile, pale brown in water mounts, straight to undulate, rarely finely encrusted, sometimes with small-sized pores, septate, often disarticulating at the septum, occasionally with dichotomous branching (Fig. 1g). Exoperidium two-layered: (1) outer mycelial layer, with 2–4 µm wide hyphal elements, interwoven with plant matter and particles of soil; (2) inner pseudoparenchymatous layer, gelatinous, up to 1 mm thick, made up of 10–20 µm in diam., rounded, thin-walled cells. Endoperidium consisting of 2–5 µm wide, thin and thick walled hyphae.

Habitat. Terrestrial, found in an ex-vineyard arid soil partially covered with xerophilic mosses.

Material examined – ITALY: Piedmont, Perosa Canavese (Torino), 45° 23' 55.19" N, 7° 50' 02.14" E, 262 m a.s.l., 10 Dec. 2009, *legit* L. Panno, *det*. A. Vizzini (TO HG1998).

Discussion

Distributed in Europe and America (Coker & Couch 1928, Calonge 1998, Kreisel 2001), where it typically grows in dry, sandy, sunlit and usually steppe-like habitats (Kers 1975, Calonge 1998, Jordal et al. 2007, Stasińka 2008), *D. bovista* is a rare gasteroid species that seems to be declining in Northern Europe. As a consequence, it has been included in the red-lists of rare and threatened macromycetes of several European countries (e.g. Switzerland, Senn-Irlet et al. 1997; The Netherlands, Arnolds & Kuyper 1996; Italy, Venturella et al. 1997; Austria, Krisai-Greilhuber 1999; Denmark, Stoltze & Pihl 1998; Poland, Wojewoda & Ławrynowicz 2004; Sweden, Gärdenfors 2005).

Disciseda bovista is characterized by the 6–7 µm diam., strongly ornamented spores, with *Terfezia*-like, truncate-conical warts, and without long sterigmal remnants. Among the closest allies, *D. candida*, which macromorphologically may be easily confused with *D. bovista*, is clearly distinguished by the smaller (3.5–5.5 µm), finely ornamented basidiospores (e.g. Kers 1975, Jeppson 1986, Mornand 1990, Moyersoen & Demoulin 1996, Calonge 1998, Poumarat et al.

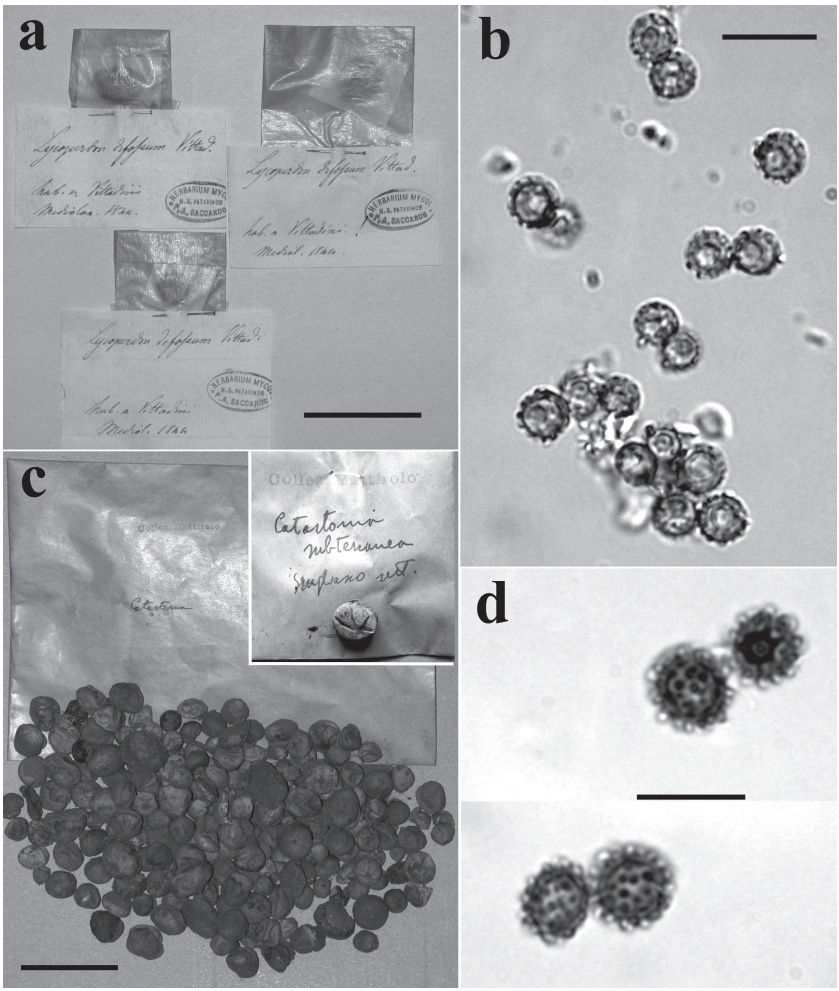

Figure 2. a–b. Vittadini's collection (PAD) – *Lycoperdon defossum*. a. Basidiomes. b. Basidiospores. c–d. Mattirolo's collection (TO) – *Catastoma subterraneum*. c. Basidiomes. d. Basidiospores. Bars: a, c = 5 cm; b, d = 10 µm.

2000, Sarasini 2005, Bates et al. 2009). *Disciseda cervina* (Berk.) Hollós has smaller (4.0–5.6 µm), smooth to asperulate basidiospores and an endoperidium often with purplish hues (Hollós 1903, Poumarat 2003, Bates et al. 2009), while the recently described *D. nigra* Dörfelt & H. Nowak from Germany differs in its blackish mature endoperidium and larger basidiospores (7.5–8.5 µm) with warts up to 1.8 µm high (Dörfelt & Nowak 2002).

As regards collections of *D. bovista* previously reported from Italy, the Italian Checklist (Onofri et al. 2005) mentions only one find from Sardinia (Brotzu 1994) included in a local checklist without any supporting data: no description, iconography, observations, or herbarium number were provided. Photos and description of the species, included in the monograph on epigeous gasteromycetes by the Italian specialist Sarasini (2005), refer to Spanish specimens.

Many authors consider *Lycoperdon defossum* Vittad. (Vittadini 1842) a synonym of *Disciseda bovista* [e.g. Petri 1909, Lloyd (Mattirolo 1934), Mattirolo 1934, Calonge 1998; but see Moravec 1958 and Sarasini 2005]. According to Stafleu & Cowan (1986), Vittadini's original specimens are preserved at TO and PAD, which we checked for *L. defossum* collections. The collection cited by Mattirolo (1934) and probably examined by Lloyd (Mattirolo 1934) is missing from TO, but we have located Vittadini's original material in Saccardo's herbarium (PAD). That collection consists of three pressed specimens from Milan (Fig. 2a) with 4–5.5 µm diam., finely to medium ornamented basidiospores (Fig. 2b) that clearly support the material in *D. candida*. This collection represents the first record of the species from Italy.

While studying and sorting out Mattirolo's herbarium of epi- and hypogeous gasteromycetoid fungi housed at TO, we were able to study a very large collection (consisting of over a hundred specimens, Fig. 2c) labelled as *Catastoma subterraneum* made in the Turin hinterland (Mattirolo 1934). Based on spore features, the collection also appears to represent *D. bovista* (Fig. 2d).

In conclusion, our paper describes the second collection — the first in recent times — of *Disciseda bovista* from Italy that can be documented with certainty. We also demonstrate that *Lycoperdon defossum* is not a synonym of *D. bovista*, but rather of *D. candida*:

Disciseda candida (Schwein.) Lloyd, Mycol. Writ. 1: 100, 1902.
= *Lycoperdon defossum* Vittad., Monogr. Lycoperd.: 33, 1842, nom. illegit., non Batsch 1789.
≡ *Globaria defossa* Quél., Bull. Soc. Bot. France 24: 327, 1878, nom. nov.
≡ *Bovista defossa* (Quél.) De Toni, Syll. Fung. 7: 101, 1888.

Acknowledgements

Our most sincere thanks are due to Prof. G. Moreno (Univ. Alcalá de Henares, Madrid, Spain) and to Dr. L. Guzmán Dávalos (Universidad de Guadalajara, Zapopan, Mexico) for their pre-submission reviews, to Prof. E. Grilli (Popoli, Italy) for improving the English text, to Dr. R. Marcucci (Herbarium, Padova) for sending the specimen of *Lycoperdon defossum*, and to Dr. S. Voyron (University of Turin, Italy) for his technical support.

Literature cited

Ahmad S. 1950. Morphology of *Disciseda cervina*. Mycologia 42(1): 148–160. doi:10.2307/3755247

Arnolds E, Kuyper T. 1996. Bedreigde en kwetsbare paddestoelen in Nederland; basisrapport met voorstel voor de Rode Lijst. Nederlandse Mycologische Vereniging/Biologisch Station Wijster.

Bates ST, Roberson RW, Desjardin DE. 2009. Arizona gasteroid fungi I: *Lycoperdaceae* (*Agaricales*, *Basidiomycota*). Fungal Diversity 37: 153–207.

Brotzu R. 1994. Contributo alla conoscenza della flora micologica del Monte Ortobene (Nuoro). Pagine di Micologia 2: 73–80.

Calonge FD. 1998. *Gasteromycetes* I. *Lycoperdales*, *Nidulariales*, *Phallales*, *Sclerodermatales*, *Tulostomatales*. Flora Mycologica Iberica vol. 3. CSIC & J. Cramer, Madrid, Berlin, Stuttgart.

Coker WC, Couch JN. 1928. The *Gasteromycetes* of the eastern United States and Canada. University of North Carolina Press, Chapel Hill.

Dörfelt H, Nowak H. 2002. *Disciseda nigra* – ein verkannter Gasteromycet. Feddes Repertorium 113(1–2): 24–29. doi:10.1002/1522-239X(200205)113:1/2<24::AID-FEDR24>3.0.CO;2-S

Gärdenfors U. 2005. Rödlistade arter i Sveriga 2005. ArtDatabanken, Uppsala.

Gube M. 2009. Ontogeny and phylogeny of gasteroid members of *Agaricaceae* (*Basidiomycetes*). Dissertation zur Erlangung des akademischen Grades doctor rerum naturalium. vorgelegt dem Rat der Biologisch-Pharmazeutischen Fakultät der Friedrich-Schiller-Universität Jena.

Hollós L. 1903. Die Arten der Gattung *Disciseda* Czern. Beiblatt zur Hedwigia 42: 20–22.

Jeppson M. 1986. Notes on some Spanish *Gasteromycetes*. Boletín de la Sociedad Micológica de Madrid 11(2): 267–282.

Jeppson M. 1997. Observations on peridial morphology in *Disciseda bovista* and *Disciseda candida*. Windahlia 22: 33–42.

Jordal JB, Gaarder G, Jeppson M, Johansen WE. 2007. *Disciseda bovista* (Klotzsch) Henn. – en steppeart ny for Norge. Agarica 27: 2–8.

Kers LE. 1975. The genus *Disciseda* in Sweden. Svensk Botanisk Tidskrift 69: 405–438.

Kirk PM, Cannon PF, Minter DW, Stalpers JA. 2008. Ainsworth & Bisby's dictionary of the Fungi. 10th ed. CABI, Wallingford.

Kreisel H. 1962. Die *Lycoperdaceae* der Deutschen Demokratischen Republik. Feddes Repertorium 64: 89–201.

Kreisel H. 2001. Checklist of the gasteral and secotioid *Basidiomycetes* of Europe, Africa, and the Middle East. Österreichische Zeitschrift für Pilzkunde 10: 213–313.

Krisai-Greilhuber I. 1999. Rote Liste gefährdeter Großpilze Österreichs. 2. Fassung, in: Niklfeld, H. (Ed.), Rote Listen gefährdeter Pflanzen Österreichs, 2. Auflage. Grüne Reihe des Bundesministeriums für Umwelt, Jugend und Familie 10: 229–266.

Larsson E, Jeppson M. 2008. Phylogenetic relationships among species and genera of *Lycoperdaceae* based on ITS and LSU sequence data from north European taxa. Mycological Research 112: 4–22. doi:10.1016/j.mycres.2007.10.018

Mattirolo O. 1934. Curiosi adattamenti intesi a permettere la dispersione delle spore nel Genere "*Catastoma* Morgan" fra le "*Lycoperdaceae*". Reale Accademia Nazionale dei Lincei Ser. VI, 5(11): 459–467.

Mitchel DH, Chapman SW, Grimes G. 1975. Studies of *Disciseda* (*Gasteromycetes*) in Colorado. Mycologia 67(3): 586–596. doi:10.2307/3758394

Moravec Z. 1958. 7. Rod *Disciseda* Czern.-Zaludice. In: Pilát A. (red.), Flora ČSR/*Gasteromycetes*. Praha, pp. 377–387.

Moreno G, Altés A, Ochoa C. 2003. Notes on some type materials of *Disciseda* (*Lycoperdaceae*). Persoonia 18: 215–223.

Mornand J. 1990. Les Gastéromycètes de France (6- *Lycoperdales*). Documents Mycologiques 20(79): 1–24.

Moyersoen B, Demoulin V. 1996. Les Gastéromycètes de Corse: taxonomie, écologie, chorologie, Lejeunia, nova series 152: 1–128.

Onofri S, Bernicchia A, Filipello Marchisio V, Padovan F, Perini C, Ripa C, Venturella G, Zucconi L, Savino E, Vizzini A, Zotti M. 2005. Check-list dei funghi italiani. Carlo Delfino Editore, Sassari.

Petri L. 1909. *Gasterales*. Flora italica Cryptogama 3(5): 1–140.

Poumarat S. 2003. Clé des *Gasteromycetes* épigés d'Europe. *Phallales*: *Geastraceae*, *Hysterangiaceae*, *Phallaceae*; *Agaricales*: *Lycoperdaceae*, *Mycenastraceae*, *Nidulariaceae*, *Phelloriniaceae*, *Tulostomataceae*; *Boletales*: *Sclerodermataceae* (genres sécotioïdes exclus). Monographies Mycologiques de la FAMM, n° 2, 2ème édit. revue et augmentée, Edit. FAMM, Nice.

Poumarat S, Neville P, Ivaldi P. 2000. Récoltes de *Disciseda candida* (Schw.) C. Lloyd dan le Var. Bulletin Semestriel de la Fédération des Associations Mycologiques Méditerranéennes 17: 35–43.

Sarasini M. 2005. Gasteromiceti epigei. Centro Studi Micologici A.M.B., Trento.

Senn-Irlet B, Bieri C, Herzig R. 1997. Provisorische Rote Liste der gefährdeten Höheren Pilze der Schweiz. Mycologia Helvetica 9(2): 81–110.

Stafleu FA, Cowan RS. 1986. Taxonomic literature. Vol. VI. Bohn, Scheltema & Holkema, Utrecht.

Stasińka M. 2008. The state of knowledge of macromycetes in xerothermic grasslands in Poland. Annales Universitatis Mariae Curie – Skłodowska, Lublin— Polonia LXIII/1/5 Sectio C: 71–78.

Stoltze M, Pihl S. 1998. Rødliste 1997 over planter og dyr i Danmark. Ministry of the Environment, Danish Forest and Nature Agency, Copenhagen,.

Thiers B. 2010. [continuously updated]. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. http://sweetgum.nybg.org/ih/

Venturella G, Perini C, Barluzzi C, Pacioni G, Bernicchia A, Padovan F, Quadraccia L, Onofri S. 1997. Towards a Red Data List of fungi in Italy. Bocconea 5: 867–872.

Vittadini C. 1842. Monographia Lycoperdineorum. Memorie della Reale Accademia delle Scienze, Ser. II, 5: 145–237.

Wojewoda W, Ławrynowicz M. 2004. Red list of threatened macrofungi in Poland (3rd ed.) [Czerwona lista grzybów wielkoowocnikowych zagrożonych w Polsce (wyd. 3)], in: Zarzycki K, Mirek Z (Eds.), List of slime moulds, algae, macrofungi, mosses, liverworts and plants threatened in Poland. W. Szafer Institute of Botany Polish Academy of Sciences, Kraków.